Framework Plan for Coordinating Activities of the Columbia River Transboundary Gas Group

Phase 1 June 2000



Prepared for:

The Columbia River Transboundary Gas Group

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by the U. S. Department of the Interior Bureau of Reclamation

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Framework Plan Description

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1

Framework Plan Description



This framework plan was prepared to facilitate the cooperative efforts that are underway to evaluate and mitigate problems associated with excessive air entrainment in waters of the Columbia River system. The transboundary area consists of the upper Columbia River basin in the northwestern United States and British Columbia, Canada upstream of Grand Coulee Dam (figure 1). This framework plan is intended to facilitate planning in the transboundary area and contribute to the broad systemwide efforts that are in progress to manage dissolved gas problems in major tributaries throughout the Columbia River system.

In early 1998, the Transboundary Gas Group (TGG) was organized to help coordinate the investigations and ongoing dissolved gas management efforts in the transboundary region of the Columbia River basin. The following United States and Canadian agencies and interest groups have participated in the TGG activities:

U.S. Environmental Protection Agency
Idaho Department of Environmental Quality
Oregon Department of Environmental Quality
Washington Department of Ecology
U.S. Bur eau of Reclamation
U.S. Army Corps of Engineers
Bonne ville Power Administration
U.S. National Marine Fisheries Service
Chelan County P.U.D.
Grant County P.U.D.
Seattle City Light
Northwest Power Planning Council
Battel le Paci fic Northwest Division

Environment Canada
B.C. Ministry of Environment
Fisheries and Oceans Canada
B.C. Hydro
Columbia Power Corporation
Cominco Ltd.
West Kootenay Power
RL&L Environmental Services
Aspen Applied Sciences
AVISTA
Colville Confederated Tribes
Spokane Tribe of Indians
International Joint Commission

The TGG organized topical workgroups to focus on the various investigations and actions relevant to address gas problems in the transboundary area. This framework plan is based on current information available in TGG planning papers and reports, and is intended to support the efforts of the TGG participants. The TGG also formed a systemwide steering committee to help coordinate and interact with other parallel dissolved gas planning efforts that are underway in the lower Columbia and Snake River basins.

Background

Air entrainment occurs as water passes over and through the large hydroelectric facilities in the Columbia River system. Excessive entrainment of air can cause elevated saturation of dissolved gases and produce health hazards, collectively described as "gas-bubble disease" for resident and migratory fishes and other aquatic organisms. The potential for harmful effects can depend on a number of variables such as gas concentration, exposure, species characteristics, migration patterns, life cycle stage, and environmental conditions.

Gas-bubble disease is a concern for fish populations in the Columbia River basin including anadromous migratory fish, species indigenous to the river, and the fisheries established in reservoir backwaters. The hazard risks are accentuated during times of higher than normal runoff, when there is less flexibility in operating facilities to reduce air entrainment.

The extent of gas supersaturation can depend on facility structural characteristics, inflow conditions, operating constraints, and the river environment. Previous investigations have indicated voluntary and involuntary spill over dams, as opposed to passing water through hydroelectric turbines, is a major factor in supersaturation. As a result, supersaturation problems are often more severe and difficult to manage during times of high runoff when more water is spilled over the major hydroelectric dams throughout the Columbia system.

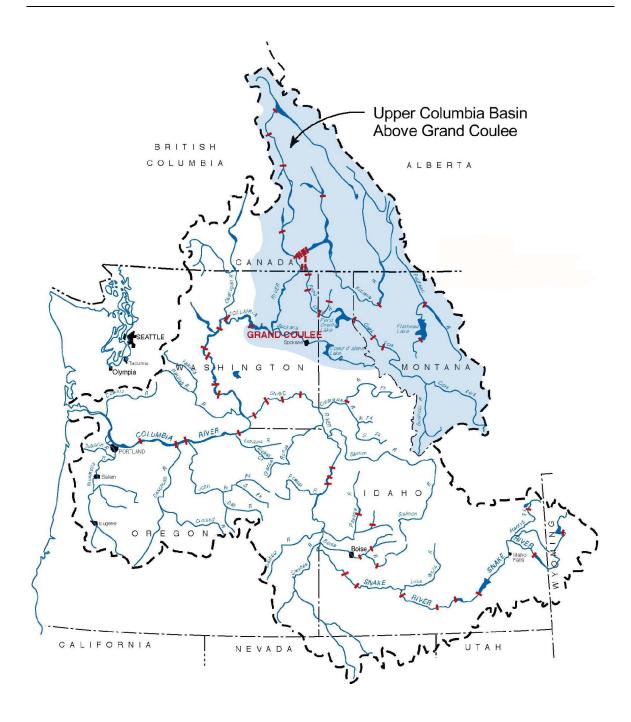
Investigations have also indicated the dissolved gas can persist for significant distances to accumulate in the river and pass through to downstream fisheries. A systemwide approach to management is considered essential since conditions at one dam can affect downstream operations. A long term effective management plan might incorporate both structural and operational measures that are feasible to reduce hazard risks in critical areas.

Historical Perspective

Periods of high flow in the Columbia River system have resulted in greater supersaturation levels that are conveyed to the next downstream facility. In some cases, total dissolved gas levels have exceeded national, provincial, state, and tribal water quality standards in both the United States and Canada. In response to concerns raised in the 1960's regarding dissolved gas problems, extensive monitoring, biological effects research investigations, and efforts to promulgate more effective water quality standards and criteria were initiated to address the gas supersaturation problems in the Columbia River system. The Columbia River watershed and the *transboundary* upper basin (shaded area) are shown in figure 1.

In 1995, the U.S. National Marine Fisheries Service (NMFS) issued a *Biological Opinion* for Operation of the Columbia River Hydro System and a supplemental was issued three years later (NMFS, 1995; 1998). The biological opinion cites concerns for salmon stocks listed under the Endangered Species Act (ESA), and recovery measures such as modifying operational spill practices, and structural improvements to reduce gas supersaturation and accommodate fish passage at the existing Columbia River hydro-power facilities.

Figure 1. Columbia River Watershed



In 1998, two coordination groups of the NMFS regional forum, the System Configuration Team (SCT) and the Dissolved Gas Team (DGT), were given the task to begin developing a systemwide approach to dissolved gas management and abatement for the Columbia River basin. Previous and ongoing efforts have concentrated on reducing dissolved gas levels at individual dams or in particular river reaches of the lower Snake River or lower Columbia River. NMFS subsequently proposed an effort to characterize the location and extent of dissolved gas production in major tributaries throughout the Columbia River system.

Transboundary Gas Group

A closely related basin-wide planning effort was initiated to evaluate and integrate dissolved gas issues in Canada and the United States. In April 1998, an international conference and workshop entitled: *Towards Ecosystem-Based Management in the Upper Columbia River Basin*, was held in Castlegar, British Columbia. This conference was attended by scientists, planners, and policy-makers from different agencies, tribes and first nations, private industry, utility owner-operators, and public interest groups in Canada and the United States.

These conference discussions identified priority concerns to address systemwide dissolved gas issues, including the need to develop; (1) a total dissolved gas management plan for the transboundary region; and (2) the capability to evaluate alternative gas abatement measures within a systemwide context

The Transboundary Gas Group was formed at the Castlegar conference to help coordinate dissolved gas planning activities between Canada, the United States, tribes and first nations, and other organizations, with the goal of facilitating systemwide management. The upper Columbia River *transboundary* area is complicated because of the different legal, political, and administrative mechanisms that influence water management. The transboundary area includes tributary basins located in Washington, Idaho, and Montana in the United States, and in British Columbia, Canada.

During subsequent TGG meeting discussions, co-chairs of the TGG were selected to assist in coordinating future TGG efforts, and the Systemwide Dissolved Gas Abatement Steering Committee was formed. In addition, technical workgroups were formed to undertake and coordinate technical activities of the TGG. The four original TGG workgroups were:

- Biological Effects and Research
- ♦ Monitoring and Information Sharing
- ♦ Modeling (Computer Simulations)
- Operational and Structural Abatement

The investigations of these workgroups are coordinated through the meetings of the TGG and the steering committee. The steering committee has responsibility to develop a study plan to direct the transboundary gas management efforts, and to coordinate the workgroup efforts in addressing technical aspects of gas management. As much as possible these TGG working groups are jointly co-chaired by U.S. and Canada representatives.

Lower Columbia River Activities

Total dissolved gas management in the lower Columbia River and Snake River are currently coordinated through a NMFS Regional Forum established to monitor progress made toward the biological opinion. Several significant efforts have been initiated in the United States to address dissolved gas problems in the Columbia River system downstream of Grand Coulee Dam. A gas monitoring program was established by the U.S. Army Corps of Engineers (COE) in cooperation with the U.S. Bureau of Reclamation (Reclamation) and public utility districts (PUD) to obtain necessary data and information (COE, 1999a). During times when high spill operation is required, the Federal Columbia River Power System (FCRPS) and mid-Columbia PUD dams are managed according to spill caps and spill priorities adopted by the Regional Forum to reduce dissolved gas levels (COE, 1999b).

The potential for new operational and structural measures for gas abatement are also under investigation in the hydro-power system downstream of Grand Coulee Dam. A number of parallel gas abatement planning activities have been initiated in lower basin areas, including the lower Snake River and lower Columbia River, the Mid-Columbia River, and the Hells Canyon Complex of the Snake River.

In 1995, the Dissolved Gas Abatement Study (DGAS) was initiated to evaluate alternative gas abatement measures for the COE facilities in the Snake River and lower Columbia River system. The DGAS study is considering the potential structural and operational changes at eight hydroelectric facilities including Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles, and Bonneville hydro-power facilities (COE, 1996; COE, 1997). Alternatives include both short and long-term actions to improve fish survival by reducing dissolved gas generation during spill operations. A number of fast-track actions to reduce gas levels have already been implemented, including installation of flow deflectors at John Day and Ice Harbor dams. Other feasibility level DGAS planning investigations are currently scheduled for completion later in 2000.

In the middle Columbia area, additional gas management activities have been initiated for other Federal and PUD hydroelectric facilities. These Mid-Columbia investigations and gas abatement planning efforts are generally at a less advanced stage of development than the ongoing DGAS program in the Snake River and lower Columbia River. Investigations of gas abatement options are also undertaken as part of the Mid-Columbia PUD re-licensing activities conducted for the Federal Energy Regulatory Commission (FERC).

In 1998, preliminary studies of structural and operational alternatives for Grand Coulee Dam were completed (Reclamation, 1998a; 1998b; 1998c). In 1999, the COE and Reclamation initiated cooperative studies to evaluate operational and structural measures to reduce gas generation at the Chief Joseph and Grand Coulee Dam complex. The alternative evaluated included combined options, such as installing flow deflectors at Chief Joseph with transfer of power loads Grand Coulee. A draft report of these findings (COE, 2000) was distributed and the combined option concept was accepted by NMFS planning review teams.

In 1999, a cooperative effort between the COE, Bonneville Power Administration (BPA), and Reclamation was initiated to develop a screening model for use in evaluating system effects of gas abatement measures at Grand Coulee and Chief Joseph Dams. In early 2000, the COE Waterways Experiment Station completed development of a total dissolved gas (TDG) model called SYSTDG for use in evaluating possible benefits and costs associated with structural and operational gas abatement measures.

This model was intended for use in predicting TDG levels in the forebay and tailwater areas of facilities in the lower Columbia (McNary, John Day, The Dalles, and Bonneville Dams); Mid-Columbia (Grand Coulee, Chief Joseph, Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids Dams); Snake River (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor Dams); and the Clearwater River (Dworshak Dam).

In the Snake River system, dissolved gas planning in the Snake River Hells Canyon Complex (Brownlee, Oxbow, and Hells Canyon Dams) and the Snake River mainstem downstream to the Salmon River confluence are under investigation by Idaho Power Company through the FERC re-licensing program. In 2000, a planning program under the Clean Water Act was initiated to evaluate dissolved gas problems in this reach as a cooperative effort between the U.S. Environmental Protection Agency (EPA), the Oregon Department of Environmental Quality, and the Idaho Department of Environmental Quality.

A series of investigations undertaken by Idaho Power (Meyers et al, 1999) have defined the relationships between reservoir operations and gas levels and the dissipation of dissolved gas in the Snake River downstream of Hells Canyon Dam. These results were applied to predict gas levels under the practical range of reservoir operations. Total dissolved gas levels below Hells Canyon dam were as high as 130 percent of saturation during spill episodes of various magnitudes, but were found to decline with further distance downstream, to reach the 110 percent TDG standard at a maximum of 67 miles downstream of the dam. Based on these results, it appears that air entrained at the Hells Canyon Complex may have little effect on dissolved gas conditions further downstream in the lower Snake and Columbia system.

These ongoing activities in the lower basin are at various levels of completion, and must be incorporated with transboundary efforts, to develop systematic basin-wide gas management plans. The status of the lower Columbia investigations and planning efforts are described in an annual gas abatement report and plan (COE, 1999).

Mitigation or coordination of dissolved gas problems in the transboundary area that reduce background dissolved gas levels could be beneficial to achieve gas abatement objective in the Mid-Columbia facilities, and possibly further downstream. The alternative of operating Chief Joseph and Grand Coulee projects coupled with construction of deflectors is one example of potential advantages gained through coordinated planning. These previous and ongoing activities in the lower basin have provided valuable information and ultimately could contribute to developing a systemwide approach to assess and resolve dissolved gas problems throughout the Columbia River system.

Goals and Objectives

This framework plan is intended to serve the goals and objectives of the Columbia River Transboundary Gas Group. In the initial planning stages, the TGG adopted the following statement as the overall long-term goal:

"Reduce systemwide total dissolved gas (TDG) to levels safe for all aquatic life in the most cost-effective manner possible."

This ultimate goal presents significant challenges given the physical scope and scale of the watershed and facilities involved, the number of potentially effected or concerned entities, and the array of different administrative and political jurisdictions that are associated with the transboundary issues. It is clear that effective coordination of the various investigations and activities of the TGG is essential to advance this comprehensive goal.

The investigations and planning efforts necessary to accomplish this ultimate goal will vary in complexity and duration. Consequently the TGG must accommodate *long-term* activities and still support appropriate *short-term* actions to alleviate gas supersaturation problems in the river in the most efficient and cost-effective manner possible.

Framework Plan Goals

This framework plan is intended to facilitate activities identified by the TGG workgroups to promote efficient use of resources and to help focus these efforts toward improved water quality management throughout the Columbia River system. Accordingly, the overall goals of this framework plan are twofold:

- ♦ Provide a framework to facilitate short and long term investigations and dissolved gas management planning efforts for the United States and Canada transboundary area of the Columbia River system.
- ◆ Provide for systemwide management of dissolved gas problems through modeling, monitoring, and operational links between the transboundary and lower Columbia River management efforts.

The framework plan is intentionally simple to minimize the amount of effort required to organize and coordinate activities. It has an open-format to allow for periodic update and tracking. It is designed to help define tasks and transfer the products needed by different workgroups. The framework is intended to accommodate short and long term activities, and to help integrate local and large scale considerations. Although the main focus is on the transboundary activities, the framework also identifies interaction with the lower basin gas management programs to integrate systemwide planning efforts.

Phase 1 Objectives

A number of specific objectives are identified for Phase 1 of the framework. The Phase 1 activities are a combination of investigations that will provide information to characterize the conditions and problems in the transboundary area and develop basic computer model capabilities to support an initial series of simulation modeling evaluations. Objectives for Phase 1 of the framework plan include:

- ♦ Complete an inventory of major facilities characteristics in the transboundary area and identify potential structural and operational gas abatement measures.
- ◆ Develop a dissolved gas database to compile monitoring data and research results for the transboundary area to support modeling and future investigations.
- ♦ Develop screening-level computer simulation models to evaluate basic dissolved gas saturation conditions and potential gas abatement alternatives.
- ◆ Define and complete an initial series of screening model scenarios to help identify predominant "hot spots" or critical areas of transboundary concern.
- ♦ Evaluate and make recommendations regarding implementation of operational measures for individual facilities to produce short-term improvement.
- ♦ Evaluate and make recommendations on the potential to expand the lower river system spill management priorities to include the transboundary area.
- ♦ Evaluate and make recommendations on structural modifications to reduce gas entrainment for further consideration and planning in Phase 2 studies.

For the most part these Phase 1 objectives focus on short term activities that could lead to immediate results and direct improvement. There are also other research investigations and planning efforts underway that contribute to the longer term TGG goals. Future framework phases are expected to incorporate additional activities as they become eminent.

Systemwide Coordination

The TGG is currently one of three major collaborative dissolved gas planning efforts in the Columbia River basin. Coordination and integration of these major planning components is essential to accomplish long-term systemwide management goals. The other major planning components are the Snake River and lower Columbia River gas abatement efforts currently in progress. Planning efforts underway in the Mid-Columbia area are considered part of the lower Columbia effort. Although several investigations have been completed and modeling tools are available for use lower basin planning, there is currently less information available for the transboundary region to support systemwide coordination.

Three major planning regions and hydro-power facilities on the Columbia River system are shown in the schematic diagram figure 2. These major sub-basin regions include the lower Columbia River, Snake River, and upper Columbia transboundary area. The dissolved gas monitoring and improvement planning efforts in these three major areas could be integrated once there is sufficient information and cooperative participation in each area. The overall intent is to integrate planning efforts to allow for systemwide analysis that could be used in developing more effective, coordinated dissolved gas management strategies.

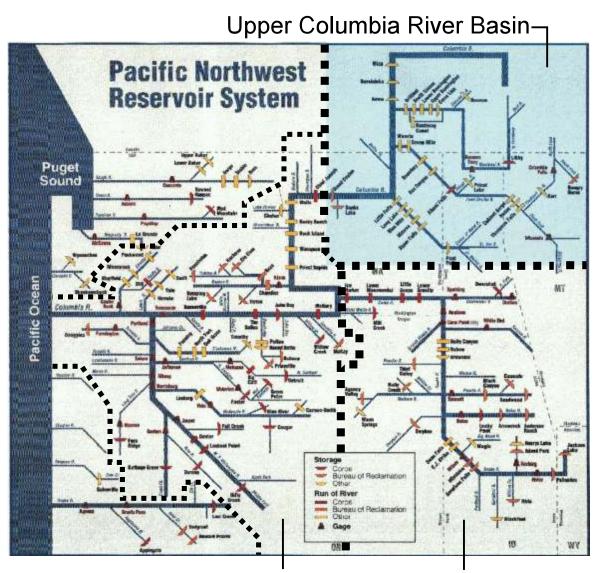
Given the magnitude of the Columbia River system and the existing hydro-power projects, a significant amount of data and information is required to characterize factors that regulate conditions within a portion of the river basin. The first step involves characterization of the existing conditions, operating parameters, and structural characteristics that affect a given reach or defined sub-basin area. Basin-wide characterization can then be followed by more detailed analyses and simulation modeling to formulate systemwide strategies to reduce the dissolved gas levels throughout the Columbia River.

Any modifications to the existing major hydro-power structures or operations could require significant expense. Systemwide planning is important to ensure that proposed actions are consistent with other activities, and minimize the overall expense. A systemwide approach to gas management may find that operational changes or structural modifications at specific locations are less costly and result in greater overall benefit throughout the Columbia River than undertaking independent separate actions. For example, Reclamation is has evaluated the feasibility of several costly structural alternatives to reduce gas entrainment attributed to spill operations at Grand Coulee Dam; however, an initial review of systematic options has indicated the dissolved gas at Grand Coulee might be reduced at less cost by implementing effective structural and operational changes at other facilities in the system.

This framework plan was developed to help facilitate appropriate short-term and long-term activities to accomplish the TGG goals and objectives. The framework plan is based on the objectives outlined in the draft study plan (TGG, 1999) and notes from early TGG planning meetings, that emphasize *systemwide* dissolved gas management. The framework plan is intended to support interactions between the modeling, monitoring, and modification efforts for the transboundary area and ultimately promote systemwide guidance and effective use of resources to improve water quality throughout the Columbia River system.

Phase 1 of the framework plan will focus on short-term activities to characterize conditions and factors in the transboundary area, and develop a working base of information and tools that are consistent with the lower ongoing basin planning efforts. In subsequent phases, the TGG can pursue more detailed investigations as needed, undertake specific implementation planning studies, and focus on integrating the transboundary activities with the lower basin planning components. As a result, subsequent phases of the TGG planning are expected to shift toward refinement of the transboundary information as required to address critical river reaches and to support the overall Columbia River systemwide coordination.

Figure 2. Columbia System Schematic



Lower Columbia River Basin

Snake River Basin

(Adapted from U.S. Army Corps of Engineers publications)

2

Cooperative Mechanisms

- ♦ Plan Formulation
- **♦** Review and Coordination
- **♦** Funding and Cost Allocation
- **♦** Phase 1 Activities

2

Cooperative Mechanisms



This section describes mechanisms and principles that are employed in the framework plan to help accomplish the goals of the Transboundary Gas Group. Successful completion of the activities identified in each phase of the framework plan will rely heavily on the ongoing cooperative efforts of the TGG workgroups and participants.

Continued funding including budgets to support cooperative participation in the TGG and the co-sponsored investigations is essential to accomplish the activities of this framework phase and achieve further progress toward the TGG goals and objectives.

The need for effective mechanisms to coordinate and track the progress of short and longer term activities was recognized in the initial TGG planning discussions. The cooperative mechanisms outlined in this framework plan are intended to facilitate tracking of activities included in the current framework phase as well as longer duration efforts.

Implementation of these mechanisms may also help to define needs for subsequent phases and help to break down short term actions to advance long term objectives. This includes coordination to anticipate future systemwide linkages with the lower Columbia River and Snake River basin planning efforts.

This section describes how the framework mechanisms are formulated to help accomplish the current phase of activities and to facilitate ongoing framework review and coordination through the TGG cooperative mechanisms. A brief discussion is included to describe the cooperative cost-share and voluntary funding mechanisms, and funding considerations that may be considered to accommodate future activities of the TGG and the overall systemwide Columbia River water quality improvement efforts.

The last pages describe specific considerations of the Phase 1 activities. Phase 1 is currently defined as a two-year effort. Phase 1 includes a variety of activities that will be undertaken by different groups that will require coordination to ensure critical products are transferred between groups and effectively integrate results into guidance for the transboundary area, and carry results forward into the systemwide planning.

Plan Formulation

The framework plan has two components. One component consists of specific tasks or activities that comprise the scope of work for a given time period (such as Phase 1) of the TGG efforts. The second component is an ongoing report that documents the conditions and status of dissolved gas management in the transboundary area. These components are the topics of Section 3 and Section 4 respectively of this framework plan.

Framework plan activities are accomplished by technical workgroups, the TGG committee chair representatives, and members of the Systemwide Dissolved Gas Abatement Steering Committee. In addition, consultants, contractors, willing participants, and other interested parties could also provide assistance with certain TGG activities.

Technical Activity Areas

The framework plan is currently organized into six activity areas that are consistent with the existing TGG technical workgroups. Structural and operational activities are separated into two activity topics and one additional area called "Framework Plan Integration" is included to define review and coordination needs to accomplish the framework plan objectives. This results in the following six activity areas in the current framework plan.

- ♦ Biological Investigations
- ♦ Structural Characteristics
- **♦** Facility Operations
- **♦** Monitoring Information
- ◆ Computer Modeling
- ♦ Framework Plan Integration

These six activity areas are shown conceptually in Figure 3. These major activity categories may be subject to change as appropriate for further phases of the TGG efforts or to address other issues that arise during the current phase. Specific activities expected in this phase of the TGG efforts are described in more detail in Section 3.

Plan Implementation

Basic functional relationships and interactions between the framework technical areas and the TGG are illustrated in figure 3. For each topical area there are one or more activities that are coordinated by the principal TGG group contacts. Activities may lead to a product intended for use by another group, or may contribute toward longer term goals.

A key element in framework implementation is the "Framework Plan Integration" activity area. The systemwide steering committee and TGG committee co-chairs are the principal contacts for framework integration. This activity is an important function to facilitate the communication and information transfer between workgroups, carry results forward and document progress, and to coordinate with lower basin management efforts.

Figure 3. Workgroup Interactions

			Short Term			Long Terr	n
*	Biological Investigations	\rightarrow	 activity activity activity 	$\overset{\rightarrow}{\rightarrow}$	\rightarrow	product ↓ goal ←	✓
*	Structural Characteristics	\rightarrow	 activity activity activity 	$\overset{\rightarrow}{\rightarrow}$	\rightarrow	product ↓ goal ←	✓
*	Facility Operations	\rightarrow	 activity activity activity 	$\begin{array}{c} \rightarrow \\ \rightarrow \end{array}$	\rightarrow	product ↓ goal ←	✓
*	Monitoring Information	\rightarrow	 activity activity activity 	$\overset{\rightarrow}{\rightarrow}$	\rightarrow	product ↓ goal ←	✓
*	Computer Modeling	\rightarrow	 activity activity activity 	$\overset{\rightarrow}{\rightarrow}$	\rightarrow	product ↓ goal ←	✓
+	Framework Plan Integration	on	‡	‡		‡	

- ⇒ Facilitate Technical Group Activity Interactions
- ⇒ Transboundary Gas Management Status Report
- ⇒ Coordinate with Lower Columbia River Planning

The five technical activity areas shown in Figure 3 correlate directly with the existing TGG workgroups and the activities identified in each area are coordinated through the respective technical workgroup co-chairs. As a result, communications and cooperative interactions between these groups are expected to occur without framework integration involvement. Framework integration is intended to be administrative and supporting in nature, to facilitate funding, reporting, and workgroup coordination. The three most prominent framework integration activities are indicated at the lower section of Figure 3.

The Transboundary Gas Management Status Report is a working document that reflects the recent activities undertaken by the TGG, upcoming events, current gas management criteria and plans, and updated reports on conditions in the transboundary area. The status report might also be distributed separately as an ongoing handout product of the TGG. Further details of the status report are provided in Section 4.

Review and Coordination

Effective framework coordination and integration is needed in planning to help break down long term goals into feasible shorter term activities, and to ensure that critical activities are completed and products are transferred between workgroups. An efficient review process is also important to evaluate results that could change applied gas management principles.

For example, the modeling group will define the monitoring needs to support the screening model. The monitoring group later provides monitoring data to the modeling group, which is then used to refine an operating model scenario. These activities could eventually lead to implementation of revised operating procedures and longer term monitoring plans that are documented in updated versions of the Transboundary Gas Management Status Report.

The framework plan is designed to be easily updated to incorporate changes and workgroup products. Results and new information will be reviewed continuously through the steering committee, co-chairs, and TGG participants.

In the long term, the implications of results and findings relevant to the transboundary area will require comprehensive review and systemwide coordination with lower basin planning efforts, the power operations treaty, and other legal and institutional authorities.

Framework Review Process

The framework plan review process is directed by the steering committee. Interim review and progress reporting is expected to occur at a minimum of every six months at the TGG biennial meetings. This process typically includes review of the current status of workgroup activities, updates to the current phase of framework plan activities, and possible revisions to the Transboundary Gas Management Status Report. The framework plan is expected to be updated periodically as the activities shift from one phase to the next. These framework review cycles can be modified at any time to accommodate needs identified by the TGG.

Summary of Framework Review Cycles

*	Workgroup progress	→	6 months at TGG meeting
*	Framework activities	→	6 months at TGG meeting
*	Status report review	→	6 months at TGG meeting
\	Framework plan	→	2 years depending on phase

The goal is to implement changes, distribute meeting notes, and produce a revised status report (if applicable) shortly after each TGG meeting. The steering committee and TGG technical workgroups will work together to address short and long term needs.

Short and Long Term Coordination

The relationships between short and long term activities are directly tied to the interactions between workgroup activities and the ultimate goals of the TGG. These overall functions and framework concepts are illustrated graphically by the flow diagram in Figure 4.

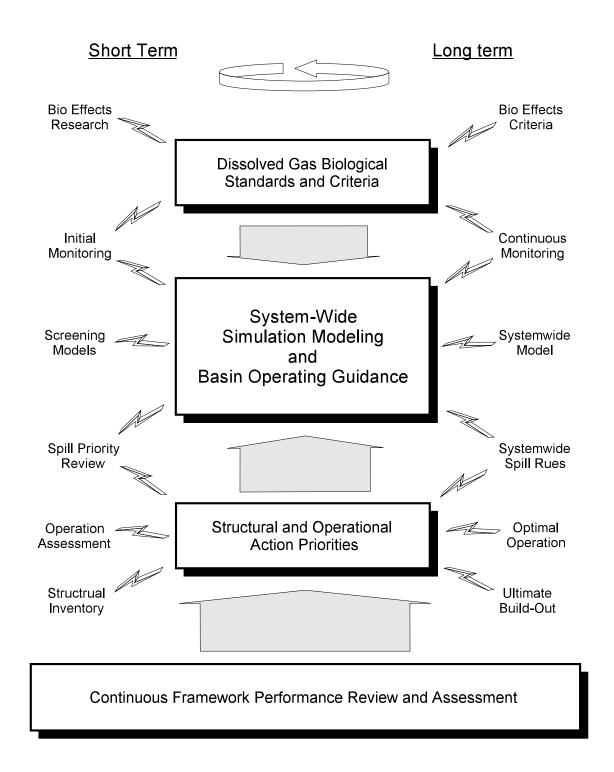
At the center of the flow diagram is the ultimate long term objective of gas management planning as a systemwide model program (with support monitoring) that is used to prepare effective basin guidance for conditions at a given time or water year. This outcome also assumes that the high priority feasible structural and operational modifications at individual facilities are in place. Short term activities that contribute to the central goal are indicated on the left side, with a shift toward the longer term actions shown on the right.

For these purposes, short and long term objectives are defined operationally. A short term activity is defined as an action that can be undertaken immediately. A short term activity has a distinct approach, workgroup, product, primary contact, and funding mechanisms, that can be summarized in an activity description sheet. Long term actions are generally more goal oriented or may have several short term tasks that are pursued in sequence.

As better information is derived and improvements are implemented, the topics indicated in the center boxes shift from short term objectives toward the longer term goal. For example, biological effects research might ultimately lead to more accurate dissolved gas criteria that accounts for critical river locations, migration factors or environmental conditions. Ideally, this information is integrated to refine simulation model analysis and develop appropriate systemwide guidance. Similarly, information derived from assessments of structural and operational conditions are used in conjunction with early modeling tests to determine the priorities for undertaking facility modifications. These actions directly improve dissolved gas conditions and eventually lead to optimization of the continuous operating criteria.

The Phase 1 framework activities focus on an interim step in this process, the development of "screening" models that are applied to identify critical hot spots and narrow the range of conditions for subsequent analyses. The short term results of Phase 1 will help to evaluate and define further activities, and work toward breaking down the other long term objectives into a sequence of short term projects and tasks.

Figure 4. Framework Flow Diagram



Funding and Cost Allocation

There are two main funding mechanisms that have been employed to date or considered to accomplish the TGG activities. The primary mechanism to date has been a cooperative basis in which participants contribute in-kind services, and in some cases have provided funds on a direct cost-share basis to accomplish certain tasks. Cooperative participation is considered essential to provide for coordination between agencies and interest organizations.

The TGG discussions have also recognized the need for definite funding sources or pooled funding mechanisms to undertake certain activities anticipated. For example, modifications to the structural facilities are very capital intensive. In general, designated funding sources will likely be needed to accomplish actions that require greater commitment of resources, or to effectively allocate the costs of specific local actions that have widespread benefits.

Thus far the TGG participants from government agencies, private utilities, facility owners, and other interested entities have acted on a strictly cooperative basis with co-sponsorship of funding or voluntary efforts. This funding mechanism has proven effective for meeting attendance, literature compilation, and relatively lower cost actions. As the tasks become more involved and potentially beyond the ability to perform tasks within these cooperative funding sources, the TGG may have to explore alternative funding methods.

To implement the framework plan, the activities for each phase are defined sufficiently to estimate funding needs and develop adequate funding sources. The steering committee, with input from TGG technical groups and co-chairs, may request volunteers to undertake activities with funding from respective agencies or employers. The steering committee and TGG co-chairs will also coordinate the funding mechanisms and proposals to perform tasks that cannot be accomplished through voluntary means.

Cooperative arrangements such as interagency agreements or memoranda of understanding may also be pursued to facilitate continued support of the TGG participants. This approach might help to reduce the time and effort spent on administrative arrangements.

As additional long term commitments are made and potential structural modifications are identified, much larger funding requirements can be expected. More substantial funding sources and pooled mechanisms might be considered to accommodate larger project needs and develop an equitable means to allocate costs between beneficiaries. Alternative funding sources might include specific appropriations or a combined funding account that is pooled from stakeholder organizations and agency budgets.

Some of the Phase 1 activities identified are already funded, whereas other tasks may require additional funding and cost-sharing provided by appropriate TGG participants requesting funds through respective management and administrative mechanisms. Larger budget items in Phase 1 may require supplemental funding sources. A rough estimated range of costs for the currently identified Phase 1 activities are summarized at the end of Section 3.

Phase 1 Activities

This discussion is intended to clarify the specific scope and approach of the current phase of activities undertaken by the TGG. Each phase of the Columbia River dissolved gas planning efforts will typically include a combination of activities that vary by duration and complexity. Nevertheless, each phase of the framework plan will likely have a central focus that is based on the immediate priorities, past progress to date, and the resources available.

The primary focus of Phase 1 is on compiling information to characterize existing conditions in the system, and developing screening models for use in identifying priorities for further refinement and developing appropriate testing scenarios. Computer simulation modeling is a fairly specialized endeavor. However, some discussion of the typical approach applied in model development can help to explain how screening models can be used effectively within the short-term transboundary scope, leading to the longer term systemwide objectives.

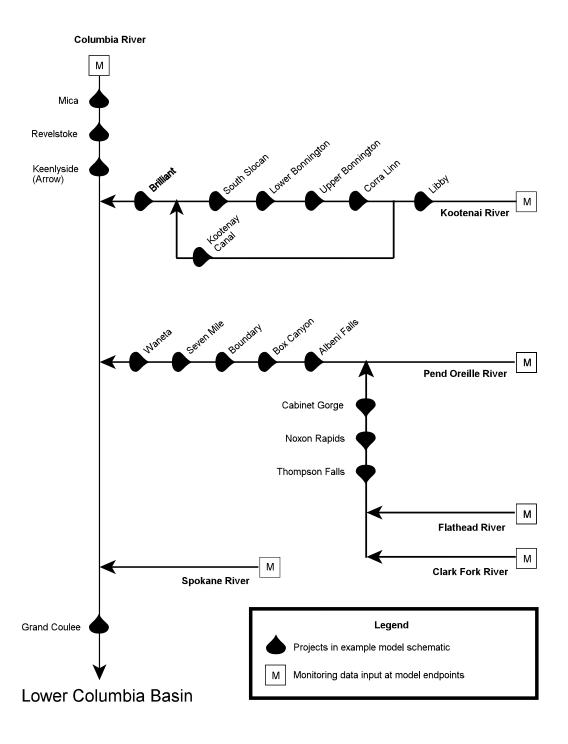
Computer models can require large amounts of data to accurately represent the functions in a given system. The amount of time and effort required for development, simulations, and interpreting results is directly related to the amount of data and information assimilated in the model structure. Screening models can be a very important preliminary step to define critical data gaps and narrow the range of test alternatives. Screening models can help to reduce model complexity, computation time, and future support needs. Screening models can be applied to evaluate fundamental alternatives to define the range of test conditions for detailed analysis. Models developed for screening purposes can often be directly expanded or refined to examine the implications of specific conditions and scenarios.

The framework plan recognizes the systemwide approach to understand total dissolved gas functions throughout the Columbia River basin in developing specific action plans to address priority areas of concern. In this case, screening models could begin with the mainstem of the Columbia River and major tributaries and then undertake expanded analysis of critical reaches or areas not adequately represented by screening trials. It is important to define the level of detail necessary before undertaking an extensive and prolonged monitoring effort.

An example basic screening model diagram is shown in figure 5. This diagram shows the basic stick model representation for major project facilities on the Columbia River, and the major tributary segments of the Pend Oreille and Kootenai Rivers. This initial configuration does not preclude future expansion to include other tributaries such as the Spokane River or the upper Flathead River, nor does it preclude further refinement to incorporate complicated functions or to represent specific components such as Roosevelt Lake.

Confluence points and endpoints are represented by monitoring data (M) as indicated in the model schematic. As a result, tributaries such as the Spokane River are not eliminated; the flows and quality values are incorporated as measured data. Endpoints can be replaced later by simulation elements to expand the model as additional data and information are available to accommodate both short and long term objectives of the TGG.

Figure 5. Screening Model Example



Even relatively simple screening models have significant data needs to characterize the areas of interest. For example, data inputs could include monitoring data at each dam for ebay and may include rating functions for specific outlet works. Necessary river monitoring data may include selected points in the upstream and downstream segments. Depending on channel geometry and hydraulic characteristics, data from other monitoring locations in the reach between projects may also be necessary to provide adequate detail.

Calibration data is also used to evaluate whether model definition is adequate and determine additional critical monitoring data needs. As a result, the initial scope of a screening model may consider the objectives for evaluating a given area, the feasibility or accuracy projected within available data, the computational requirements, and time limitations or the extent of development effort required.

There may be a trade-off between developing an adequate model to accomplish screening purposes and undertaking an extensive prolonged data collection program. In any case, the screening models should be developed to consider and allow for future linkages to expand the analysis based on initial screening results and incorporate further refinement as additional data become available. These Phase 1 activities will go a long way toward defining model simulation capabilities for the transboundary and systemwide objectives.

3

Technical Group Activities

- ♦ Biological Investigations
- **♦** Structural Characteristics
- **♦** Facility Operations
- **♦** Monitoring Information
- **♦** Computer Modeling
- ♦ Framework Plan Integration
- **♦** Phase 1 Summary and Costs

3

Technical Activities



This section describes activities included in Phase 1. This section is organized into topical activity areas that are separated by divider sheets so that the activities within a given topic can be easily found. There are five subsections for the technical workgroup activities and one subsection for the Framework Integration activities. The last subsection is a summary of the critical products and expected costs for all of the Phase 1 activities.

Information concerning the scope and participants involved in each activity (or project) are summarized in one-page activity description sheets. An example of the activity description sheet format is shown in Figure 5. These description sheets provide basic information such as project title, participants, workgroup for coordination, and a brief summary of the scope and products. References to detailed project information are also indicated.

The activity description sheets are only intended to facilitate planning and coordinating the various TGG efforts undertaken by different workgroups. These description sheets do not replace other working project proposals, abstracts, or technical documentation.

The activity description sheets focus on single actions and allow a quick view of activities and products in a given area. The sections can be readily updated to include descriptions of new activities or to modify the scope as projects change. The topical areas and description sheets may also help to identify new activities, break down activities into manageable short term tasks, and target results to focus on the long term goals and critical products.

Review and update of the activities undertaken by each of the TGG technical workgroups is expected to occur regularly in the same time frame as the TGG meetings to report on the status of activities and update the activity description sheets. The ongoing tasks and work actions undertaken by workgroups are not restricted to the description sheets.

New activities or revisions to activities described are initiated as soon as they are identified and can be started by workgroup members. Description sheets can be prepared or updated afterward. New or revised activity sheets should be prepared by the workgroup members and forwarded to the steering committee to incorporate into the framework plan.

Example - TGG Activity Description Sheet

Pı	oject Title:	Title of Project or Activity	Identity:	XX-YR.01		
			Started:			
Workgroup:		(One of the workgroups or steering committee)				
Contact:		(Name and agency of primary project contacts)				
Participants:		(Names of major participating groups - not individuals)				
Purpose:		(Intent from standpoint of contributions to TGG obj	ectives)			
D	escription:		Update:	1/07/00		
(Brief description of the project, investigation or tasks) (Note: intended for identity in framework coordination - the more detailed scope of work, or research abstracts and reports are independent of this - conditional direct inquiries to additional project information as appropriate) (Target completion duration and products anticipated) (Possible reference to additional information available)						
	nort Term coducts:	(This refers to the use or routing of information to o modify and incorporate into the updated management				
Long Term Application:		(This refers to the overall objectives or implications short term task and long term framework plan appro	-	within the		

Biological Investigations

Biological Investigations

The primary technical responsibility for addressing biological investigations needs of the Transboundary Gas Group lies with the Biological Effects and Research Workgroup. The workgroup conducted a detailed review of existing information relating to biological effects of total dissolved gas supersaturation and a summary of outstanding research needs in initial phases of transboundary gas planning. Findings (Fidler, Antcliffe, Birtwell, and Pinney; 1999) were presented to the entire TGG and steering committee for consideration.

The workgroup report recommended that a comprehensive research plan be prepared to address the biological knowledge gaps which limit existing gas modeling efforts. Under the approach developed by the workgroup, additions and improvements to biological components of gas modeling efforts were to be developed. Biological components would be used to assist in management of spill, establish site specific water quality objectives, and assess and prioritize gas abatement alternatives. The workgroup strategy called for enhancement of predictive tools for optimizing spill and dollars spent on gas abatement before initiation of transboundary and systemwide gas abatement planning.

Discussions on biological risk assessment within the entire TGG and the steering committee focused on the planning nature of TGG goals, rather than the research based approach to development of biological effects modeling tools that was brought forward by the Biological Effects and Research Workgroup. The need for a short term initiative to reduce dissolved gas levels in the transboundary area was stressed in this planning effort.

Representatives of Canada chose to conduct biological risk assessments based on existing biological information in transboundary reaches of the Columbia mainstem, Kootenai River, and Pend Oreille River. The alternative standards based approach assumes that there is a direct relationship between a certain level of dissolved gas produced and the associated risk to fish and aquatic resources.

Because of the over riding need to initiate gas abatement planning and implementation immediately, based on existing tools and information, the short term biological investigations needs defined in this framework plan are limited to the biological risk assessment proposed by representatives from Canada. However, it is generally recognized that additional goal oriented research and site specific biological information needs may be defined in later, more detailed studies of gas abatement alternatives.

TGG Activity Description Sheet

	<i>y</i>	Description sheet				
Project Title:		Transboundary total gas pressure (TGP) biological risk assessment	Identity: Started:	BI-99.01 12/01/99		
Workgroup:		Biological Effects and Research				
Contact:		Bonnie Antcliffe, Department of Fisheries and Oceans Julia Beatty, B.C. Ministry of Environment, Lands, and Parks; CRIEMP				
Participants:		Columbia River Integrated Environmental Effects Monitoring Committee (CRIEMP)				
Pu	Purpose: Identify key biological resources at risk due to elevated TGP in the transboundary reaches of the Columbia, Kootenai, and Pend d'Oreille Rivers.					
De	escription:		Update:	1/20/00		
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7	Columbia River from Keenleyside Dam to the international boundary, the Kootenai River downstream of Kootenay Lake, and the Pend d'Oreille River from Boundary Dam downstream. A summary of TGP data in the transboundary area will be prepared to describe the location, frequency, and duration of elevated gas levels. The biological inventory will include fish species distribution, relative abundance, life history phases, habitat utilization, and behavioral patterns which could influence vulnerability to TGP. Information such as horizontal and vertical distribution in the water column, daily patterns, migratory patterns, location and depth of spawning areas, vertical distribution after emergence, location and depth of larval and juvenile rearing habitat, and adult behavior patterns will be evaluated relative to the summarized TGP data. Key fishery resources and life history phases at risk to elevated TGP and any periods of reduced biological risk for spill will be identified.					
	ort Term oducts:	Results of this study will go to the TGG for review and evaluation of possible implications to transboundary planning guidelines and criteria.				
Long Term Application:		In the long term these investigations could be used in water quality standards and criteria associated with				

Structural Characteristics

Structural Characteristics

The Operational and Structural Abatement Workgroup was formed to investigate the gas generation characteristics of hydroelectric facilities and dams in the transboundary area, and to take the lead in identifying structural abatement measures for evaluation in systemwide analyses. The workgroup membership has close ties to project owners and operators in the transboundary area, and will serve to gather structural information and gas abatement alternatives developed for the individual projects and compile data for use in systemwide planning. This effort will also coordinate with other efforts such as the U.S. Army Corps of Engineers (USACE) Dissolved Gas Abatement Study (DGAS) program, as appropriate.

An initial product of the workgroup involved compilation of an inventory and preliminary ranking of storage and hydroelectric dams for gas abatement studies, based on estimated gas generation potential (Operational and Structural workgroup, 1999). Gas generation potential of facilities was estimated from the structure physical characteristics, hydraulics, experience reported by project owners, and dissolved gas monitoring, where available.

Additional Framework Plan activities related to structural characteristics and gas abatement options include (1) compilation of detailed information on flow and structural hydraulic characteristics, and (2) identification of structural gas abatement alternatives under consideration by owners of major dams and hydroelectric facilities in transboundary reaches of the Columbia, Kootenai, and Pend d'Oreille Rivers. Structural gas abatement alternatives would be screened in systemwide modeling evaluations to determine options that should be studied in more detail as part of further phases of gas abatement planning.

TGG Activity Description Sheet

	*				
Project Title:	Inventory of dams and existing gas generation characteristics	Identity: Started:	ST-99.01 11/01/98		
Workgroup:	Operational and Structural Abatement				
Contact:	Bijou Kartha, B.C. Ministry of Environment Keith Binkley, Seattle City Light				
Participants:	Project Owners/Operators and the Operational and Structural Abatement Workgroup				
Purpose:	The purpose of this project is to compile physical data related to gas generation for major dams in the Columbia River basin and rank facilities for further study.				
Description:		Update:	1/20/00		
2 Under this act 3 with informat 4 location, occu 5 professional ju 6 abatement stud	with information on the physical characteristics of the facility, project ownership, purpose, location, occurrence of upstream and downstream projects, and dissolved gas data or best professional judgement on gas generation potential. A ranking of dams for systemwide gas abatement studies was completed, based on the size of the facilities, position within the system, and the best available estimate of gas generation potential. 8 9 0 1 2 3 4 5 6				
Short Term Products:	The inventory was provided to the Systemwide Dissolved Gas Abatement Steering Committee to assist in study plan development and formulation of systemwide alternatives.				
Long Term Application: The focus of plan formulation efforts will narrow further as more specific studies become available.		erther as more o	data and site		

TGG Activity Description Sheet

7	Description sneet			
Project Title:	Identify structural alternatives to evaluate transboundary gas planning	Identity: Started:	ST-00.02	
Workgroup:	Operational and Structural Abatement			
Contact:	Bijou Kartha, B.C. Ministry of Environment Keith Binkley, Seattle City Light			
Participants:	Project Owner/Operators and the Operational and Structural Workgroup with technical assistance for the U. S. Army Corps of Engineers Program staff			
Purpose: The purpose of this activity is to identify and describe the full range of structural gas abatement alternatives available at transboundary facilities.				
Description:		Update:	1/07/00	
2 B.C. Hydro, to districts in the gas abatement of problems at the reduction benefits identify further structural Ab Dissolved Gas	districts in the United States are involved in planning and investigations related to structural gas abatement measures, expansion/upgrade of power plant facilities, maintenance or replacement of outlet works, and other actions which might partially mitigate dissolved gas problems at the project level. This activity would compile and summarize the costs and gas reduction benefits ongoing project-level structural gas abatement planning activities, and identify further options needing consideration in systemwide evaluations. The Operational and Structural Abatement Workgroup will coordinate with U.S. Army Corps of Engineers Dissolved Gas Abatement Study program staff on technical aspects of defining short term alternatives and priorities.			
Short Term Products:	Results will go to the Systemwide Dissolved Gas Ab Committee for use in prioritizing projects on a system		ng	
Long Term Application:	Based on systemwide modeling results, projects wou plan to achieve system gas abatement objectives at the			

♦ Facility Operations

Facility Operations

The Operational and Structural Abatement Workgroup has primary responsibility for identifying and describing the potential operational measures for dissolved gas abatement under the framework plan. The workgroup will provide liaison with the project owners, provide technical assistance in identifying operational gas abatement measures, and help facilitate technical assistance from other efforts including U.S. Army Corps of Engineers Dissolved Gas Abatement Study (DGAS) program, as appropriate.

The Framework Plan strategies for operational considerations under Phase I are two-fold. The first short-term objective is to identify project specific operational gas abatement criteria for transboundary facilities for possible early implementation. The second focus is to explore and evaluate the option of expanding the Federal Columbia River Power System (FCRPS) spill and dissolved gas management program to include transboundary facilities.

Framework plan activities include working with project owners to identify short-term project specific operational measures to abate gas at facilities on the Columbia, Kootenai, and Pend d'Oreille Rivers in the transboundary area. The workgroup will also provide oversight of a project to formulate systemwide operational strategies which would expand the scope of current gas management operating criteria on the lower river. Operational gas abatement strategies will be evaluated using systemwide modeling tools developed by the Modeling Workgroup.

The Evaluations of operational alternatives will address concerns of transboundary project owners and action agencies of the FCRPS. If a decision is made to expand the current criteria for spill and gas management in the lower river to include transboundary facilities, later phases of study may focus on development of institutional arrangements for managing spill on a systemwide basis.

TGG Activity	Description Sheet			
Project Title:	Identify short-term operational measures for trans boundary gas abatement	Identity: Started:	OP-00.01	
Workgroup:	Operational and Structural Abatement			
Contact:	Bijou Kartha, B.C. Ministry of Environment, Lands Keith Binkley, Seattle City Light	, and Parks		
Participants:	Project Owners/Operators and the Operational and S Workgroup, with technical assistance from US Arm DGAS program staff			
Purpose:	To identify, assess, and facilitate implementation of measures to reduce gas production in the transbound	_	rational	
Description:		Update:	1/20/00	
4 hydroelectric for spill config amounts of ga ysystem power would compile criteria of trans gas production Army Corps	hydroelectric facilities in the transboundary area. Operational measures include optimization of spill configurations, preferential use of those outlet conduits which generate the smallest amounts of gas, maximizing generation, and operation of turbines at speed-no-load when system power loads do not permit full use of power plan hydraulic capacities. This activity would compile and summarize the structural and hydraulic characteristics and operating criteria of transboundary facilities, and recommend short-term operational measures to reduce gas production. The Operational and structural workgroup will coordinate with the U.S. Army Corps of Engineers Dissolved Gas Abatement Study program staff on technical aspects in defining short term alternatives and priorities.			
Short Term Products:	Results of this activity will go to the Systemwide Di Steering Committee for recommendation of short ter by project owners/operators in the transboundary ar	m implementat		
Long Term Application:	As system modeling capability improves emphasis vispecific to system operations strategies for gas abate	•	from project	

Project Title: Workgroup: Contact: Participants:	Define alternative systemwide operational strategies Operational and Structural Abatement Mark Schneider, US National Marine Fisheries Serv Dave Wilson, B.C. Hydro Facilitated by NMFS and B.C. Hydro, with particip owners/operators and other appropriate entities		OP-00.02		
Purpose:	Develop and analyze systemwide operational strategies for reducing gas production in the transboundary area of the Columbia River basin.				
3 production in 4 management p 5 facilities and o 6 Kootenai, and 7 dissolved gas 8 Columbia pub 9 the NMFS Re 0 identified by o	This project will focus on formulation of cooperative operational strategies to reduce gas production in the Columbia River system. Initial efforts will focus on expansion of the gas management plan for the Federal Columbia River Power System to incorporate Canadian facilities and other non-Federal dams in the U.S. transboundary reaches of the Columbia, Kootenai, and Pend d'Oreille Rivers. During periods of voluntary and involuntary spill, dissolved gas is managed throughout the Federal Columbia River Power System and at Mid-Columbia public utility district facilities according to spill caps and spill priorities adopted by the NMFS Regional Forum. Appropriate participating agencies and private entities will be identified by co-facilitators, and an expanded spill priority list based on existing information and a coarse level of analysis will be prepared.				
5 6 7 Short Term Products: Long Term Application:	Results of the study will be presented to the System Abatement Steering Committee to consider implementation of spill management beyond the FC development of an institutional framework.	ntation actions			

Monitoring Information 3.14 Columbia River Transboundary Gas Group

Monitoring Information

The Monitoring and Information Sharing Workgroup has primary technical responsibility for managing framework plan tasks associated with planning and implementing total dissolved gas monitoring activities, including development of protocols, coordination of system monitoring, data management, and summary reporting. Project owners will have responsibility for installation and maintenance of monitoring equipment, conducting necessary transects and near-field studies, and making information available to the other TGG workgroups.

The workgroup has identified available total dissolved gas data in Canada and the United States, prioritized projects according to the relative need for further monitoring, and estimated costs for several expanded monitoring options (Monitoring and Information Sharing Workgroup, 1999). The workgroup found that some total dissolved gas data is available for most major dams and hydroelectric facilities in the transboundary area. The Framework Plan monitoring strategy provides for a focused effort to assure availability of adequate data for model development, calibration, and verification in the transboundary reaches of the Columbia, Kootenai, and Pend d'Oreille Rivers.

Framework Plan activities identified for the Monitoring and Information Sharing workgroup include implementation of a Phase I Monitoring program, based on data needs identified by the Modeling Workgroup. Implementation of monitoring would be conducted in coordination with project owners. The Monitoring and Information Workgroup is also tasked with providing technical oversight for a project to describe existing dissolved gas conditions in the transboundary area, based on summary and evaluation of existing data. This evaluation would expand on previous summaries of data from projects in Canada (Columbia River Integrated Environmental Monitoring Program Committee, 1999).

Monitoring strategies during Phase II and beyond will likely shift to establishment of fixed station monitors to support real-time spill management, and additional site specific studies to meet data needs for detailed evaluations of gas abatement alternatives.

Project Title:	Develop monitoring plans for initial screening models	Identity: Started:	MI-00.01	
Workgroup:	Monitoring and Information Sharing	Started.		
Contact:	Andrea Ryan, Environment Canada Jack Gakstatter, US Environmental Protection Agen Faith Ruffing, Sun Mountain Reflections	су		
Participants:	Project owners/operators and the Monitoring Informinput from the Modeling Workgroup	ation Workgro	up based on	
Purpose:	This activity would provide for collection of the initi existing dissolved gas models in the transboundary r Kootenai, and Pend d'Oreille Rivers.			
Description:		Update:	1/20/00	
3 bathymetry, a 4 Modeling Wo 5 transport char 6 and Pend d'O 7 primary respo 8 Information V 9 monitoring pr 0 1 2 3 4 5 6 7	bathymetry, and topography data and any additional near field or transect studies needed by the Modeling Workgroup to define relationships between spill and gas generation and describe gas transport characteristics at facilities in the transboundary reaches of the Columbia, Kootenai, and Pend d'Oreille Rivers. Hydroelectric project owners and operators would have the primary responsibility for data gathering at transboundary facilities. The Monitoring Information Workgroup will provide for coordination, technical assistance and review of monitoring protocols and study plans.			
Short Term Products:	Information developed under this activity will be pro Workgroup for use in initial screening model develo		odeling	
Long Term Application:	Gas generation curves and gas transport relationship will provide a mechanism for system wide screening	_		

100 Hellvily	Description sheet			
Project Title:	Characterize existing dissolved gas conditions in the transboundary area	Identity: Started:	MI-00.02	
Workgroup:	Monitoring and Information Sharing			
Contact:	Andrea Ryan, Environment Canada Jack Gakstatter, US Environmental Protection Agen Faith Ruffing, Sun Mountain Reflections	су		
Participants:	Project Owners/Operators, the Monitoring and Infor Workgroup, and Contractor	mation Sharing	g e	
Purpose:	This project would provide a description of dissolved transboundary reaches of the Columbia, Kootenai, a based on existing data.	-		
Description:		Update:	1/20/00	
2 Under this act 3 and summariz 4 exceedances of 5 evaluated for of 6 the 1999 Colu 7 conducted by 8 Columbia Pow 9 B.C. This act 0 the US. Proje	and summarized. The magnitude, frequency, seasonal distribution, and duration of spills and exceedances of dissolved gas water quality standards and other planning criteria would be evaluated for each facility in the transboundary area. The project would recognize and build on the 1999 Columbia River Integrated Environmental Monitoring Program (CRIEMP) project conducted by RL&L Environmental Services at Canadian facilities for B.C. Hydro, the Columbia Power Corporation, COMINCO, West Kootenay Power, and the city of Nelson, B.C. This activity would expand on the CRIEMP project and extend the analysis to dams in the US. Project owners and operators would be responsible for providing project specific dissolved gas data to be included in the analysis.			
Short Term Products:	The project will be used by the Systemwide Dissolve Committee to identify 'hot spots' and prioritize gas activities.		_	
Long Term Application:	This activity will eventually provide a baseline for mabating gas in the transboundary area.	neasuring prog	ress in	

Computer Modeling

Computer Modeling

The Modeling Workgroup has lead responsibility for managing technical aspects of total dissolved gas model development and use under the Framework Plan. The Modeling Workgroup will coordinate with project owners and the monitoring workgroup to compile existing data and define information gaps which must be filled to complete development of dissolved gas modeling capabilities for transboundary areas of the Columbia, Kootenai, and Pend d'Oreille Rivers. The workgroup will assure that dissolved gas model simulations developed for the transboundary area can be used in combination with existing models for spill optimization and gas abatement planning in the lower Columbia and Snake Rivers to provide for systemwide analytical capabilities.

The Modeling Workgroup has evaluated several types of models that are currently in use in the lower Snake and Columbia Rivers, and which appear to have potential for systemwide evaluation of gas management options (Modeling Workgroup,1999). The workgroup provided estimated levels of effort and costs of applying the models on a systemwide and transboundary area level. Concurrently, the Federal Columbia River Power System (FCRPS) action agencies initiated development of a spread sheet dissolved gas model with capability to optimize spill and system power loads, and maintain dissolved gas below standards and guidelines.

The Phase I modeling strategy is intended to move ahead with development and calibration of two dissolved gas models, a one-dimension (1D) hydrodynamic temperature and dissolved gas transport model, and the spreadsheet model developed for the FCRPS by the U.S. Army Corps of Engineers Waterways Experiment Station. The development of dual modeling capabilities will keep future options for model application open, provide temperature modeling capability, maintain the option of adding a biological component to the planning model, provide for spill optimization, and assist system managers in meeting power loads and gas standards and guidelines.

Specific modeling activities included in Phase 1 are:

- 1. Identify data gaps for model development.
- 2. Calibrate and verify the 1D gas transport and spreadsheet models.
- 3. Apply the models for evaluation of initial structural and operational gas abatement measures on a systemwide and transboundary level.

More detailed evaluations of gas abatement alternative in later planning phases may require development of more data intensive 2D modeling capability or addition of biological effects criteria for specific river reaches.

		•		
Project	Title:	Identify data and information needs for screening models	Identity: Started:	CM-00.01
Workg	roup:	Modeling		
Contac	t:	Julia Beatty, B.C. Ministry of Environment, Lands, Marshall Richmond, Battelle NW	and Parks	
Particip	oants:	The Modeling Workgroup, with technical assistance Engineers Waterways Experiment Station modeling		y Corps of
Purpos	e:	This activity would provide the scope of a data colledevelopment of dissolved gas screening models for t		
Descrip	tion:		Update:	1/20/00
2 This 3 topo 4 addit 5 trans 6 Arm 7 spres 8 Wate	topography data for the Columbia, Kootenai, and Pend d'Oreille Rivers, and identifying additional data needed to configure, calibrate, and verify dissolved gas screening models for the transboundary area. Data needs of the Battelle NW gas transport model developed for the US Army Corps of Engineers (USACE) in the lower Snake and Columbia Rivers and a spreadsheet dissolved gas and power model currently under development at the USACE Waterways Experiment Station will be compiled and compared with existing information. An integrated description of data needs to develop and calibrate these two models will be prepared.			
Short T Produc		The compilation of data needs will be used to define determine critical data gaps to incorporate into mon-	_	lels and to
Long T		Results will facilitate development of systemwide di models for evaluation of gas abatement options.	ssolved gas scr	eening

Project Title: Workgroup: Contact: Participants:	Develop spreadsheet model for screening operational alternatives Modeling Julia Beatty, B.C. Ministry of Environment, Lands, Marshall Richmond, Battelle NW The Modeling Workgroup, and US Army Corps of Environment Station Staff		CM-00.02 ACE)	
Purpose:	To develop an operational model for use by system and facility managers to optimize systemwide power and dissolved gas generation effects of a range of gas abatement alternatives.			
Description:		Update:	1/20/00	
3 in evaluating of 4 The model words facilities in the 6 constraints, for 7 dissolved gas 8 and spill flows 9 leaving the pro 1 comparable to 1	A spreadsheet dissolved gas model would be developed to assist facility and system managers in evaluating effects of real-time operational decisions on gas levels and power generation. The model would predict total dissolved gas levels in the forebay and tailrace areas of all facilities in the system, provide for flow and spill optimization, account for transmission constraints, follow spill priorities and caps, meet system power loads, and maintain total dissolved gas below standards and guidelines. The model will calculate required powerhouse and spill flows and predicts TDG, based on input data including total flows entering and leaving the project, pre-defined spill requirements, powerhouse hydraulic capacity, discharge-to-megawatt conversion factors, and spill-to TDG relationships. The model would be comparable to the COE spreadsheet model under development for the Columbia River downstream of Grand Coulee Dam and the Snake River downstream of Lower Granite Dam.			
Short Term Products:	7 Short Term This model would assist the Systemwide Dissolved Gas Abatement Steering			
Long Term Application:	This model will facilitate evaluation and implementa management and operational gas management option		_	

	Description sheet			
Project Title:	Develop one-dimensional transport model for screening alternative evaluations	Identity: Started:	CM-00.03	
Workgroup:	Modeling			
Contact:	Julia Beatty, B.C. Ministry of Environment, Lands, Marshall Richmond, Battelle NW	and Parks		
Participants:	Modeling Workgroup, Bonneville Power Administra	ation, Battelle N	١W	
Purpose:	Development of a 1D gas transport model to facilitate of transboundary gas abatement measures on a system	_	d evaluation	
Description:		Update:	1/20/00	
2 Under this pro 3 (developed fo 4 reaches of the 5 model that car 6 estimates of h 7 simulates a br 8 Standard mod 9 dissolved gas 0 and a verage tr 1 approach, star	Under this project, a hydrodynamic temperature and dissolved gas transport model, MASS1, (developed for the Dissolved Gas Abatement Program), would be applied to the transboundary reaches of the Columbia, Kootenai, and Pend d'Oreille Rivers. MASS1 is a one-dimensional model that can accommodate unsteady river flow. The model calculates cross-section average estimates of hydraulic and water quality conditions in the river or reservoir system, and simulates a branched river channel as a set of links and individual points along each link. Standard model output includes discharge, water surface elevation, velocity, temperature, dissolved gas concentration, depth, a rea, hydraulic radius, channel top width, friction slope, and a verage travel time and bee shear stress. The model would be implemented in a phased approach, starting with the best available data and then refined in the future as additional data are collected and funds become available.			
Short Term Products:	7 Short Term The model would be used to assist the Systemwide Dissolved Gas Abatement			
Long Term Application:	Model results may be integrated into systemwide eva or three-dimensional analysis in specific areas to gai of conditions in specific areas as adequate data beco	n more accura	-	

	•		
Project Title:	Screening model evaluations of gas management alternatives	Identity: Started:	CM-00.04
Workgroup:	Modeling		
Contact:	Julia Beatty, B.C. Ministry of Environment Lands a Marshall Richmond, Battelle NW	nd Parks	
Participants:	The Modeling Workgroup, with technical assistance Engineers and contractor staff	from U.S. Arr	ny Corps of
Purpose:	The purpose of this activity is to determine the systellevel effectiveness of operational and structural gas at facilities in the transboundary area.		
Description:		Update:	1/18/00
 2 The spread sh 3 of gas abatem 4 various combined 5 and structural 6 Operational and 7 Dissolved Gas 8 technical over 	of gas abatement alternatives would be used to simulate systemwide dissolved gas levels with various combinations of structural and operational abatement measures in place. Operational and structural gas a batement measures evaluated under this activity would be provided by the Operational and Structural Abatement Workgroup, in coordination with the Systemwide Dissolved Gas Abatement Steering Committee. The Modeling Workgroup would provide technical oversight of simulations and assure the most appropriate of the two available models are used for evaluation of each alternative.		
Short Term Products:	The simulations produced under this activity will be Dissolved Gas Abatement Steering Committee to for for advanced planning and implementation of gas ab	rmulate recomi	nendations
Long Term Application:	More detailed evaluations may be needed on short ri advanced planning of structural gas abatement meas		ring

Framework Plan Integration

Framework Plan Integration

These activities are accomplished or coordinated primarily by the TGG steering committee and TGG chairs with assistance by respective working groups and support staff. There are three major ongoing activities that are constant to implement this framework plan.

- 1) To track progress of TGG workgroup activities and facilitate and the transfer of critical products between workgroups.
- 2) To review and compile significant results of the TGG activities and incorporate results in the Transboundary Gas Management Status Report
- 3) To compile relevant information and coordinate major transboundary results with the lower Columbia River gas management efforts.

Integration Assistance and Support

The Systemwide Dissolved Gas Abatement Steering Committee has primary responsibility for implementing the Transboundary Gas Group Framework Plan. The steering committee will coordinate among the various technical workgroup activities and integrate workgroup and contractor products into planning reports which summarize results and recommend actions, including advanced gas abatement planning and implementation projects.

The Framework Plan management strategy involves oversight by the steering committee, coordination and management of planning activities, and preparation of interim and final reports. The steering committee would provide liaison with agencies, project owners, and the regional forum and other appropriate entities to secure regional endorsement and commitments of in-kind and financial resources needed to complete the planning and implementation of a systemwide gas management program.

An active steering committee with staff support will be critical to maintaining the focus of technical workgroups and assuring development and implementation of actions that will accomplish the overall goals of the Transboundary Gas Group. Periodic reconsideration of the steering committee membership may be necessary to assure representation of technical groups and project owners in Canada and the United States.

The two primary integration activities included in the Phase 1 scope are expected to be a constant need for this and future phases of the TGG efforts. Other important integration needs and support activities could be defined at any time during Phase 1 or the subsequent framework plan implementation phases.

Framework Plan - Phase 1

	•		
Project Title:	Coordinate transboundary and long-term systemwide planning efforts	Identity: Started:	PI-00.01
Workgroup:	Systemwide Dissolved Gas Abatement Steering Com	nmittee	
Contact:	Les Swain, British Columbia Ministry of Environment, Lands and Parks Jim Ruff, US National Marine Fisheries Service Mary Lou Soscia, US Environmental Protection Agency		
Participants:	Systemwide Dissolved Gas Abatement Steering Concontracted study coordinator	nmittee and ag	encies or a
Purpose:	This activity would provide for over-all coordination Transboundary Dissolved Gas Management Plannin	-	nent of
Description:		Update:	1/20/00
2 This activity v 3 and project ov 4 technical work 5 management of 6 7 Program mana 8 Dissolved Gas 9 Fisheries Serv 0 also be mainta	and project owners to secure staff and budget resources to complete work items, direct technical workgroup and contractor tasks, collate work products, provide oversight and management of study plan revisions, and prepare TGG status reports. Program management would be conducted with guidance and direction from the Systemwide Dissolved Gas Abatement Steering Committee. Coordination with ongoing National Marine Fisheries Service Regional Forum dissolved gas planning programs in the United States will also be maintained. This study coordination function is expected to require about a quarter-time commitment of a staff person for the duration of the study.		
Short Term Products:	This function will assist the steering committee in as commitments are in place to complete critical technic provide central direction to transboundary gas mana	cal planning ac	tivities, and
Long Term Application:	This function will likely shift to institutionalizing tramana gement programs in the long term.	insboundary ga	ıs

	Description sheet		
Project Title:	Update Transboundary Dissolved Gas Management Status Report	Identity: Started:	PI-00.02
Workgroup:	Systemwide Dissolved Gas Abatement Steering Com	nmittee	
Contact:	Les Swain, B.C. Ministry of Environment, Lands, ar Jim Ruff, U.S. National Marine Fisheries Service Mary Lou Soscia, U.S. Environmental Protection Ag		
Participants:	Systemwide Dissolved Gas Abatement Steering Con other contracted staff	nmittee and age	encies or
Purpose:	The purpose of this activity is to provide an updated Management Plan Status Report at the end of an init		-
Description:		Update:	1/20/00
2 This activity of a management if 4 biological risk 5 formulation of 6 the state of ga 7 recommend fur 8 analyses cond	management in the transboundary area. Results of workgroup activities related to monitoring, biological risk assessment, modeling and screening tool development, spill management, and formulation of gas abatement plans will be integrated into a status report which will describe the state of gas management at the end of the first two years of planning. The report will recommend further planning needs defined through completion of preliminary coarse-level analyses conducted during the initial planning phase. The Systemwide Dissolved Gas Abatement Steering Committee will provide guidance and oversight of status report preparation and content.		
Short Term Products:	The status report will be provided to the Transbound an ongoing documentation of progress and describe advanced planning needs.	-	
Long Term Application:	The report will assist in integrating results of transbomanagement plan, which includes monitoring, opera abatement components.		-

1 0 0 Helivity	Description Sheet		
Project Title:	Evaluate existing treaty implications for dissolved gas management in the Columbia River basin	Identity: Started:	PI-00.03
Workgroup:	Systemwide Dissolved Gas Abatement Steering Com	mittee	
Contact:	Les Swain, B.C. Ministry of Environment, Lands, and Jim Ruff, U.S. National Marine Fisheries Service Mary Lou Soscia, U.S. Environmental Protection Ag		
Participants:	Systemwide Dissolved Gas Abatement Steering Comother contractor support staff	mittee and age	encies or
Purpose:	This activity would analyze the international treaty r management of total dissolved gas in the transboundar River Basin.		
Description:		Update:	1/20/00
2 This project w 3 River Treaty, 4 total dissolved 5 between interr 6 issues related 7 system would 8 treaties may fa 9 measures at tr 0 International J	River Treaty, the Boundary Waters Treaty, and the Pacific Salmon Treaty on management of total dissolved gas in the transboundary area of the Columbia River basin. The relationships between international treaties and domestic water quality laws would be described. Current issues related to mitigation or enhancement of water quality conditions in the Columbia River system would be described in the context of existing treaties. The extent to which the various treaties may facilitate or constrain implementation of operational and structural gas abatement measures at treaty and non-treaty dams would be evaluated. The potential role of the International Joint Commission in providing for comprehensive studies of gas management opportunities by the Canadian and U.S. governments will be identified and investigated.		
Short Term Products:	A project report will be provided to the Systemwide Steering Committee to clarify treaty aspects of gas m Columbia River basin.		
Long Term Application:	The project will likely be used in the long-term to de framework for funding of gas abatement measures at transboundary area.	-	

Phase 1 Summary and Costs

Phase 1 Summary and Costs

This section summarizes the current framework phase project activities that are defined in the previous activity description sheets. The table in this section provides a brief overview of the project title, identification, description, current status (proposed, ongoing, complete), and the estimated costs or funding mechanism.

The estimated cost range indicated is intended for planning purposes to provide a basis for developing funding sources to accomplish the activities of Phase 1. The costs shown are only a rough planning level range and will require review and revision once specific project activities have been defined by the workgroup participants. Activities indicated as in-kind funding are expected to be accomplished through voluntary cooperative mechanisms.

For these purposes, any in-kind services and other voluntary contributions are indicated as no cost. These working arrangements are considered indispensable to the ultimate success of the long term TGG goals and objectives. Hopefully continued involvement by the TGG participants can be supported by respective agency and industry budgets. Continuation of existing cooperative arrangements eliminates the need to develop complicated mechanisms and thereby allows efforts to be directed toward the tasks at hand.

Framework Plan - Phase	Framework Plan - Phase 1 Activity and Funding Summary			
Project Title	Description	Cost		
Biological Investigations				
BI-99.0 Transboundary TGP biological risk assessment	Inventory aquatic biota and fisheries resources in the Canadian reaches of the Columbia River and summarize TGP data and relationships to provide a basis for risk assessment. Ongoing	In-kind		
Structural Characteristic	es			
ST-99.01 Inventory of dams and existing gas generation characteristics	Catalog major dams, physical characteristics and entrainment properties for use in screening model development and definition. Complete	In-kind		
ST-00.02 Identify structural alternatives for transboundary gas planning	Identify alternatives for structural modifications for the major hydro-power facilities for use in initial modeling and planning evaluations. Proposed	In-kind		
Facility Operations	<u> </u>			
OP-00.01 Identify short-term operational measures for gas abatement	Identify any feasible operating procedures that can be initiated immediately to improve dissolved gas conditions in the transboundary area. Results also used for screening model definition. Proposed	In-kind		
OP-00.02 Define alternative systemwide operational strategies	Formulate strategies for coordinated systemwide operations that could be evaluated in screening models and future planning efforts Proposed	In-kind		
(1 of 3)				

Framework Plan - Phase 1 Activity and Funding Summary			
Project Title	Description	Cost	
Monitoring Information			
MI-00.01 Develop monitoring plans for initial screening models	Monitoring plans to support screening models only encompassed critical data needs identified in the initial screening model development. Proposed	In-kind	
MI-00.02 Characterize transboundary existing gas conditions	Compile and summarize existing dissolved gas data for the transboundary area for input and calibration of screening models. Results also used to determine critical monitoring data needs. Proposed	\$30-35K	
Computer Modeling			
CM-00.01 Identify data and information needs for screening models	Coordinated effort between model and monitoring workgroups to define needs to support all screening model development efforts. Proposed	\$15-20K	
CM-00.02 Develop spreadsheet model for operational alternatives	Develop and test COE SYSTDG model for use in power operations screening for the transboundary area and possible systemwide linkage. Proposed	\$75-90K	
CM-00.03 Develop 1-D transport model for screening evaluations	Develop and adapt MASS1 transport model for use in evaluating the transboundary reaches and assess critical areas for advanced modeling. Proposed	\$75K to 100K	
CM-00.04 Screening model evaluations of gas management alternatives	Complete initial screening alternative assessments using MASS1 and spreadsheet models to evaluate conditions in the transboundary region and future linkages for systemwide planning. Proposed	\$60-70K	
(2 of 3)			

Framework Plan - Phase 1 Activity and Funding Summary					
Project Title	Description	Cost			
Framework Plan Integra	Framework Plan Integration				
PI-00.01 Coordinate transboundary and long-term systemwide planning	Coordinate with technical workgroups, dam project owner-operators, and facilitate staff resources and budget development to support the transboundary and systemwide planning efforts. Proposed	\$75-80K			
PI-00.02 Transboundary Dissolved Gas Management Status Report	Assemble TGG meeting notes, technical workgroup products and information to prepare periodic status update reports. Proposed	\$35-40K			
PI-00.03 Existing treaties implications for dissolved gas management in the Columbia River basin	Evaluate treaties to clarify possible implications on gas management, and help to develop institutional mechanisms for funding gas abatement measures at treaty dams in the transboundary area. Proposed	\$15-20K			
(3 of 3)					

4

Transboundary Gas Management Status Report

- ♦ Management Status Update
- ♦ Applicable Criteria and Standards
- **♦** Current Individual Project Conditions
- **♦** Systemwide Operational Guidelines
- **♦** TGG Contact List

4

Transboundary Gas Management Status Report



This working report summarizes the recent activities of the Transboundary Gas Group, the current dissolved gas management conditions and criteria applied in the transboundary area, and related systemwide planning activities in the Columbia River system. The status report is reviewed periodically to incorporate the recent information pertaining to:

- Update of recent events and activities in progress.
- List of important meetings, conferences and upcoming events.
- Current standards and management criteria applied in the transboundary area.
- Current structural and operational conditions at major transboundary facilities.
- Status of systemwide coordination, including links to the lower basin activities.
- Reference information and a listing of TGG participants and contacts.

This status report is intended to document the current gas management strategies, criteria, and ongoing investigations for each phase of transboundary planning activities. This status report does not replace technical documentation; however, it provides a synopsis of recent accomplishments and other information relevant to the transboundary planning efforts.

Recording the ongoing status of transboundary efforts may also be useful to help coordinate with parallel activities in the lower Columbia River basin. As the transboundary activities are completed the contents of this status report will shift toward systemwide guidance and operating procedures for long-term dissolved gas management.

A listing of the current working group co-chairs and primary contacts is provided at the end of this status report. Reference citations, notes from the TGG meetings, and other reference materials are also provided in the framework plan appendices.

Periodic updates to the Transboundary Gas Management Status Report will be prepared as possible shortly after review at the Transboundary Gas Group meetings.

Management Status Update

This update summarizes TGG milestones and activities through March 2000.

Steering Committee and TGG Co-chairs

Current members of the Systemwide Dissolved Gas Abatement Steering Committee are: Les Swain from the British Columbia Ministry of the Environment, Land, and Parks; Mary Lou Soscia of the U.S. Environmental Protection Agency, and Jim Ruff of the U.S. National Marine Fisheries Service. The current TGG co-chairs responsible for coordination of the TGG activities are Colin Gray from Environment Canada and Mark Schneider from U.S. National Marine Fisheries Service.

Transboundary Gas Group Meetings

Formation of the TGG: April 27-30, 1998; Castlegar, B.C.

Subsequent Meetings of the TGG: June 11, 1998 - Spokane, WA

> October 15, 1998; Vancouver, B.C. February 18, 1999; Seattle, WA April 29, 1999; Spokane, WA September 30, 1999; Nelson, B.C. March 16, 2000; Spokane, WA

Upcoming Meetings, Conferences, Events

Next TGG Meeting: October 12, 2000; Vancouver, B.C.

contact: Mark Schneider for information NMFS DGT meetings:

NMFS SCT meetings: contact: Bill Heylin for information at

bill.hevlin@noaa.gov

British Columbia / Washington

Environmental Cooperation Council

Meetings:

contact: Cassie Doyle; B.C. Ministry of Environment Lands and Parks, or Tom Fitzsimmons; Washington

Department of Ecology

Other Meetings or Conferences:

Forward relevant information to the TGG co-chairs, or to the systemwide steering

committee members.

TGG Activities and Milestones to Date				
April 1998	TGG formed at the international conference and workshop: Towards Ecosystem-Based Management in the Upper Columbia River Basin			
April 1998	Transboundary Gas Group adopted the overall goal: "Reduce systemwide total dissolved gas to levels safe for all aquatic life in the most cost-effective manner possible"			
May 1998	Letter requesting participation in the Systemwide Dissolved Gas Abatement Steering Committee			
October 1998	TGG technical workgroups and co-chair representatives volunteered to coordinate TGG activities.			
January 1999	Biological literature review prepared			
May 1999	Initial structural hydro-power inventory completed			
June 1999	Draft plan of study and monitoring needs prepared to document TGG goals and planning efforts to date			
March 2000	Letter to Columbia Power Corporation from United States TGG participants in support of Brilliant Dam expansion plans			
February 2000	TGG draft framework plan distributed for review			
May 2000	TGG Framework Plan presented to the British Columbia / Washington Environmental Cooperation Council			

Applicable Criteria and Standards

This section describes the water quality standards and criteria that are currently applicable to the ongoing evaluations of the transboundary area. The criteria and standards cited are taken from TGG meeting minutes and are the result of the consensus acceptance of certain standards to move forward the TGG goals and objectives. The applicable water quality criteria and standards are applied with respect to dissolved gas and related fishery problems in the transboundary area. As more information becomes available, changes in the criteria would be reported here to indicate the current status.

The TGG adopted the criteria of 110 percent saturation for Total Dissolved Gas (TDG) or the equivalent Total Gas Pressure (TGP). Although further investigation of the appropriate TDG/TGP criteria could result in changes in the future, the 110 percent saturation criteria will be applied in gas management evaluations until new criteria are accepted.

In Canada, 110 percent TGP is a guideline for water depths greater than 1 meter at sea level (Fidler and Miller, 1997). This standard would apply to most Columbia River reaches with depths up to 30 meters, but not to projects near Vancouver Island, British Columbia where shallow depths are often encountered.

The United States Environmental Protection Agency adopted a TDG criteria of 110 percent saturation under the Clean Water Act. The National Marine Fisheries Service has prepared biological opinion documents that call for spill management to benefit endangered aquatic species. Waivers are periodically granted to allow for short term elevated TDG conditions.

The average 7-day high flow,10-year recurrence interval hydrologic event will be applied as the flow standard for evaluation of operational and structural modifications. This criteria is consistent with the flow frequency and magnitude criteria used in dissolved gas planning in the lower Columbia River basin.

Current Individual Project Conditions

This section is intended to provide an inventory and technical description of the dams and the dissolved gas characteristics in the transboundary area. This task has been completed by the Structural and Operational and the Monitoring and Information Sharing technical workgroups.

The major hydroelectric projects in the transboundary area are reflected in the schematic of the Columbia River in figure 2. The major projects facilities in the transboundary area are summarized in Appendix B. Further structural references for the entire Columbia River basin are available at the TGG Internet web-site home page.

One project in the TGG geographic area has completed extensive investigations to reduce entrainment at their site. BC Hydro, owners of the Keenleyside project near Castlegar, BC have performed extensive studies and currently optimized operations to the extent possible without undertaking structural modifications. A power plant is under construction on the left abut ment which will aid in reducing spill, and associated gas production.

Other projects have undergone some level of gas abatement review. For example, RL&L Environmental Services Ltd. presented a summary of this work on the Kootenai River at the September 1999 meeting (referenced in Monitoring work plan). These initial studies may lead to additional operational changes and power facility modifications to reduce gas entrainment. These actions will be incorporated into further investigations and progress reports of the TGG.

Systemwide Operational Guidelines

This section describes the current systemwide operating conditions and criteria that are applied within the defined transboundary area.

At this point, all facilities are operated on primarily an individual basis. In some cases, the spill procedures or structural modifications that affect spill operations have been explored or implemented at a given facility as discussed previously.

Discussion has already been initiated by the TGG to consider adoption of the spill priority criteria applied in the lower Columbia River system. This issue is included for further review as part of the TGG framework Phase 1 investigations.

Systemwide operating criteria are considered a key long term objective and final product of the Transboundary Gas Group. Results from the screening models, combined later with other long-term tasks including biological studies, produced under the Phase 1 framework plan are ultimately intended to provide the information necessary to develop more accurate systemwide operational criteria.

TGG Contact List

The following list of contacts for the TGG committees and workgroups was last updated March 2000. Please update as necessary with each issuance of the TGG dissolved gas management status report and/or TGG meeting notes.

Co-chairs of the Transboundary Gas Group

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Systemwide Dissolved Gas Abatement Steering Committee

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TGG Technical Workgroup Co-Chairs

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Co-chair - to be determined

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Co-chair - to be determined

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Julia Beatty-Spence
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Nelson, BC V1L 4K3

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Marshall Richmond Battelle Pacific NW Laboratory P.O. Box 999, MS K9-33 Richland, WA 99205 Phone: (509) 372-6241

E-mail: marshall.richmond@pnl.gov

References

- **♦** Literature Cited
- **♦** Internet Sources

Literature Cited:

Columbia River Integrated Environmental Monitoring Program Committee. 1999. Summary CRIEMP Report: 1999 Total Dissolved Gas Pressure Monitoring in the Columbia River Basin in Canada. Drafted by R.L. & L. Environmental Services Ltd., Castlegar, B.C.

Fidler, L.E., B.L. Antcliffe, I.K. Birtwell, and C.A. Pinney. 1999. Biological Effects of Total Gas Pressure on Fish and Aquatic Biota and Outstanding Research Needs. Biological Effects and Research Workgroup report to the Transboundary Gas Group.

Fidler, L.E., and S.B. Miller, 1997. British Columbia Water Quality Criteria for Dissolved Gas Supersaturation - Technical Report. Contract report to the B.C. Ministry of Environment, Department of Fisheries and Oceans, And Environment Canada. Aspen Applied Sciences Ltd., Cranbrook, British Columbia.

Modeling Workgroup. 1999. Computational Modeling of Dissolved Gas Transport and Mixing in the Columbia River Basin. Workgroup report to the Transboundary Gas Group.

Monitoring and Information Sharing Workgroup. 1999. Draft Monitoring and Information Sharing Study Plan. Workgroup report to the Transboundary Gas Group.

Myers, R., S. Pierce, M. Stute, and J. Trainer. 1999. Hells Canyon Complex Total Dissolved Gas Study Progress Report, March, 1999. Idaho Power Environmental Affairs, Boise Idaho.

National Marine Fisheries Service. 1995. Endangered Species Act Section 7 Re-initiation of Consultation on 1994-1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years - Biological Opinion. NMFS, Northwest Region.

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Operational and Structural Workgroup. 1999. Preliminary ranking, Columbia River basin storage and hydroelectric facilities, based on total dissolved gas generation potential. Report to the Transboundary Gas Group.

U.S. Army Corps of Engineers. 1996. Dissolved Gas Abatement Study, Phase I Technical Report. North Pacific Division, Portland and Walla Walla Districts.

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- U.S. Army Corps of Engineers. 1999b. 1999 Total Dissolved Gas Management Plan. Northwestern Division, Portland OR.
- U.S. Army Corps of Engineers. 2000. Chief Joseph Dam, Columbia River, Washington, Gas Abatement Study General Evaluation Report. North Pacific Division, Seattle District.
- U.S. Bureau of Reclamation. 1998a. Structural Alternatives for TDG Abatement at Grand Coulee Dam, Preliminary Concepts Report. U.S. Bureau of Reclamation, Technical Service Center, Denver Colorado.
- U.S. Bureau of Reclamation. 1998b. Structural Alternatives for TDG Abatement at Grand Coulee Dam, Conceptual Design Report. U.S. Bureau of Reclamation, Technical Service Center, Denver Colorado.
- U.S. Bureau of Reclamation. 1998c. Operational Alternatives for Total Dissolved Gas Management at Grand Coulee Dam. U.S. Bureau of Reclamation, Technical Service Center, Denver, Colorado.

Internet Access Sources

Information provided includes a references for TGG Internet web-site where information and literature is available, a list of references for the literature cited in the framework plan, and a list of the primary contacts for the TGG committees and working groups.

TGG Internet Web-site Home Page:

http://www.nwd-wc.usace.army.mil/TMT/1999/tbdry/tdg-con.html

Biological research abstract:

http://www.nwd-wc.usace.army.mil/TMT/1999/tbdry/research_needs0127.htm

Monitoring and information sharing plan:

http://www.nwd-wc.usace.army.mil/TMT/1999/tbdry/monitoring.htm

Structural and operational plans:

http://www.nwd-wc.usace.army.mil/TMT/1999/tbdry/stops tableA.htm

http://www.nwd-wc.usace.army.mil/TMT/1999/tbdry/stops tableB.htm

Major Columbia River system projects:

http://www.nwd-wc.usace.army.mil/TMT/1999/tbdry/Table1 june1499.htm

Appendix A

♦ TGG Meeting Notes

Appendix B

♦ Columbia River Project Facilities

Major Projects in the Upper Columbia Transboundary Basin Area.

Project	Owner / Operator	Use	River	Data
COLUMBIA HEAD	WATERS			
Spil lam acheen	BC Hydro	Generating	Spillam acheen	
Mica	BC Hydro	Treaty Dam	Columbia	Y
Revelstoke	BC Hydro	Generating	Columbia	Y
Walter Hardman / Coursier	BC Hydro	Generating	Cranberry	
Whatshan	BC Hydro	Generating	Whatshan	
Hugh Keenleyside	BC Hydro	Treaty Dam	Columbia	Y
KOOTENAY BASIN	N .			
Aberfeldie	BC Hydro	Generating	Bull	
Elko	BC Hydro	Generating	Elk	
Libby	Corps of Engineers	Flood / Power	Kootenay	Y
Duncan	BC Hydro	Treaty Dam	Duncan	
Corra Linn	West Kootenay Power	Generating	Kootenay	Y
Upper Bonnington	West Kootenay Power	Generating	Kootenay	Y
Bonnington Falls	City of Nelson	Generating	Kootenay	
Lower Bonnington	West Kootenay Power	Generating	Kootenay	Y
South Slocan	West Kootenay Power	Generating	Kootenay	Y
Kootenay Canal	BC Hydro	Generating	Kootenay	Y
Brilliant	Columbia Power Corp. / West Kootenay Power	Generating	Kootenay	Y

Major Projects in the Upper Columbia Transboundary Basin Area.

Project	Owner / Operator	Use	River	Data	
PEND OREILLE BASIN					
Hungry Horse	Bureau of Reclamation	Irrigation / Generating	South Fork Flathead	Y	
Kerr	Montana Power Co. / Salish-Kootenai	Generating	Flathead		
Milltown	Montana Power Co.	Generating	Clark Fork		
Thompson Falls	Montana Power Co.	Generating	Clark Fork	Y	
Noxon Rapids	Avista	Generating	Clark Fork	Y	
Cabinet Gorge	Avista	Generating	Clark Fork	Y	
Albeni Falls	Corps of Engineers	Generating	Pend Oreille	(Y)	
Box Canyon	Pend Oreille PUD	Generating	Pend Oreille	Y	
Boundary	Seattle City Light	Generating	Pend Oreille	(Y)	
Seven Mile	BC Hydro	Generating	Pend Oreille	Y	
Waneta	Cominco / West Kootenay Power	Generating	Pend Oreille	Y	
SPOKANE BASIN		1		1	
Post Falls	Avista	Generating	Spokane		
Upriver	City of Spokane	Generating	Spokane		
Upper Falls	Avista	Generating	Spokane		
Monro e Street	Avista	Generating	Spokane		
Nine Mile	Avista	Generating	Spokane		
Long Lake	Avista	Generating	Spokane		
Little Falls	Avista	Generating	Spokane		